

On the copulation in *Phyllolabis hemmingseni* Peder Nielsen and *Phyllolabis mannheimsiana* Peder Nielsen (Limoniinae, Tipulidae, Diptera)

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Dedicated to Dr. B. Mannheims on the occasion of his 60th birthday.

In the past an enormous amount of work has been done in figuring and naming the hypopygial organs of Limoniinae. These organs are of the greatest importance in the classification. But it seems as if the great diversity and confusion existing in the naming has diverted interest from the function of the organs. The present paper is but a small contribution to the large amount of work that remains to be done on this point.

The desirability of studying the function of the more or less branched hypopygial appendages of sternite 9 in the genus *Phyllolabis* Osten Sacken, 1877, was pointed out in a previous paper (Hemmingsen, 1962, pp. 155-156). Out of the two new species, found by me in the island of Gran Canaria, the one, *Phyllolabis hemmingseni* Peder Nielsen, 1959, is among the species with highly complicated and branched appendages, whereas the other one, *Ph. mannheimsiana* Peder Nielsen, 1961, is among those with least developed and least complicated appendages. A study of copulation in these two species is thus likely to be representative of the whole genus. Mating tests were, therefore, instituted in 1965 with flies collected in the same areas as on earlier occasions (cf. Peder Nielsen, 1959 and 1961, Hemmingsen, Mannheims and Peder Nielsen, 1959).

The localities were largely slopes on the "umbria" side of the barrancos (river beds; Hemmingsen 1958, p. 217) and were covered with low more or less grassy vegetation; in the Barranquillo de Atalaya, mainly with *Oxalis cernua* Thunb.

Including later findings of *Ph. hemmingseni* also in new areas in the northern part of Gran Canaria (Moya, Valleseco, Fontanales) and for the first time in the southern, driest part of the island (Santa Lucia), the localities and dates were as follows:

Ph. hemmingseni:

Northern part of Gran Canaria.

Barranquillo de Atalaya (500—600 m). 10. and 16. I. 1965 none. On 9 dates 24. I.—28. II. (1957, 1960, 1965); common.

Los Tilos (= Tiles), Moya (500—600 m). 4. II. 1965 (1 ♀). El Palo, El Convento, Valleseco (800—900 m). 26. II. 1965; common.

Acequia de Marrero in Barranco de la Higuera, near San Mateo (700—800 m). 13. and 30. I. 1965 none. On 4 dates 6. II.—18. III. (1957, 1960, 1965); rather common.

Barranco de la Lechucilla — Barranco de los Viñatigos (1000—1300 m). 30. I. 1965 none. On 5 dates 9. II.—25. III. (1957, 1960, 1965); common.

Fontanales (900—1000 m). 9. III. 1965 (1 ♂).

Southern part of Gran Canaria.

El Pico de las Hoyas, Santa Lucia (710 m). 12. III. 1965 (1 ♂).

Epecially at the beginning of the season females were in minority. There is a tendency to later emergence with rising altitude.

Ph. mannhemsiana:

Barranco de la Lechucilla — Barranco de los Viñatigos (1000—1300 m). On 5 dates 9. II.—9. III. (1960, 1965); several.

Acequia de Marrero in Barranco de Higuera, near San Mateo (700—800 m). 6. II. 1960; a few.

In spite of numerous attempts with 51 females and 114 males of *Ph. hemmingeni* and 11 females and 60 males of *Ph. mannhemsiana*, copulation was obtained in the first species only in 5 pairs on 25. 1. — 13. 2. 1965; and in the second species, not at all. From the results with the first species and the structure of the hypopygium in the second species, the copulation of the latter can only be guessed.

It was first thought that insufficient cage space might have been the reason for earlier negative mating tests. But also in a cylindrical cage of black netting 88 cm high and 35 cm in diameter the tests were negative; and in it the males — not the females — soon died from unknown reasons, filled up with air bubbles.

The flies were usually rather sluggish by day, but became more active toward evening, though the environmental temperature was 20° C or a little more all the time. Therefore, though in the free some flies were taken in flight by day, the mating tests were made at night, all the flies caught on any certain day being placed in a glass jar 7,5 cm high and 9,5 cm in diameter. They usually lived for a few days if some green leaves were added to the jar to prevent desiccation.

The males were anxious enough to copulate; and often more than one male attacked the same female. The only explanation I can offer of the unwillingness of the females to copulate is that copulation may take place at night immediately after emergence. I have never seen any copulation pairs in nature though at their special localities the flies were extremely common; and though the localities were visited at all times of the day

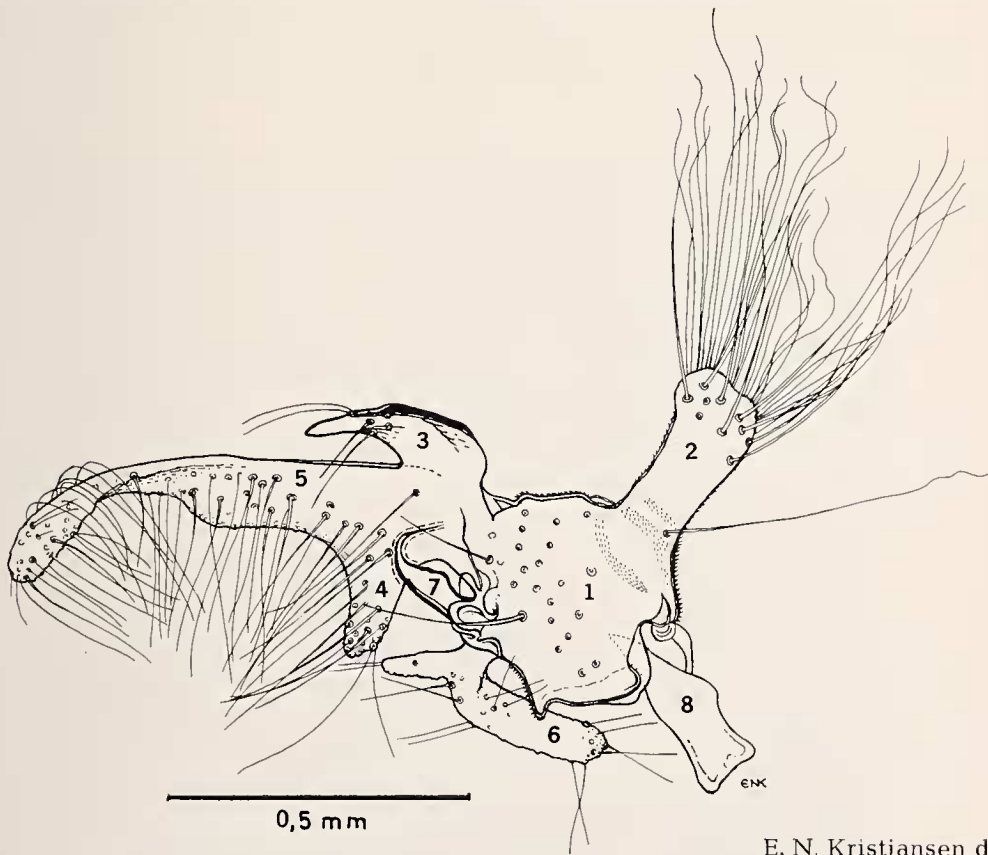
from dawn to dusk. Recently emerged flies were not seen either, except perhaps in a few doubtful cases.

The lower edge of the cerci is serrated in both species, but nothing is known as regards oviposition.

Phyllolabis hemmingseni Peder Nielsen, 1959.

Fig. 1 shows the hypopygium of *Ph. hemmingseni*. The various parts are numbered to facilitate discussion.

According to kind information by Dr. Ch. P. Alexander, Amherst, Mass., U.S.A., who has investigated hypopygia presented to him of this and the following species, 1 and 2 represent the basistyle; 3, 4 and 5, the dististyle. Dr. Alexander pointed out that beside the parts pictured in the description by Peder Nielsen (1959, fig. 2, and 1961, fig. 3) there are two further tiny appendages, a pendant fleshy lobe (6 in the figure), which is a projection from the basistyle and a slender rod (7) that extends into a filament and



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Fig. 1. Right part of the hypopygium of *Phyllolabis hemmingseni*. Drawn from preparation in Canada balsam. The numbers homologize with fig. 4. 1 and 2: basistyle with appendage 6 (and 8?). 3, 4 and 5: dististyle with 7 (see text). 7 and 8 extend mesially.

seems to be separate from the main dististyle but undoubtedly is a dististyle or part of the dististyle. Actually Mannheims (1959, pp. 153—154) mentions two dististyles (od and id) in *Phyllolabis*. But according to Alexander other species have a single style, the structures sometimes considered as representing a second or inner dististyle actually being the outer blade of the basistyle (Alexander 1961, p. 141). The whole question of misnaming might result from inability to see the sutures between the parts (Alexander in litt. 1967). Dr. Alexander thinks that there is no other species with the style more complicated in outline than this one. Using the most primitive and generalized species, *Ph. zionensis* Alexander, 1948, from Utah as a base, the homologies of the more specialized forms may be traced.

A further appendage (8) not present in Dr. Alexander's sketch (in litt.) extends mesially like 7, but apparently from the basistyle.

In the figure given by Peder Nielsen (1959, fig. 2, and 1961, fig. 3) no special attention was paid to the shape and sclerotization of part 3, presumably essential for grasping the female. Fig. 2 is a photograph of the copulation and fig. 3 shows it schematically.

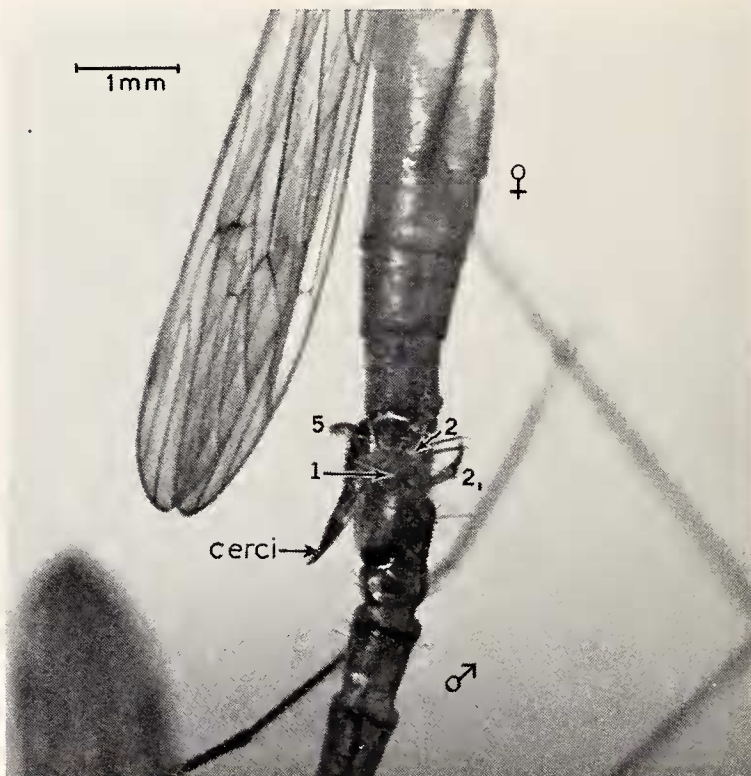


Fig. 2. Copulation in *Phyllolabis hemmingseni*. Numbers as in fig. 1. The hairs of 2 on the right side are seen to intervene with hairs of 2₁ from the left side.

Between parts 1 and 5 (broken line in fig. 3) there is evidently a sort of joint or suture, for during copulation part 5 is strongly bent, and grasps the part (the "stalk" = tergite 9) rostrally to the cerci which stand out freely (cf. figs. 2—3). During copulation the inwardly curved long hairs on part 2 intervene mutually from either side rhythmically. Part 3 is strongly

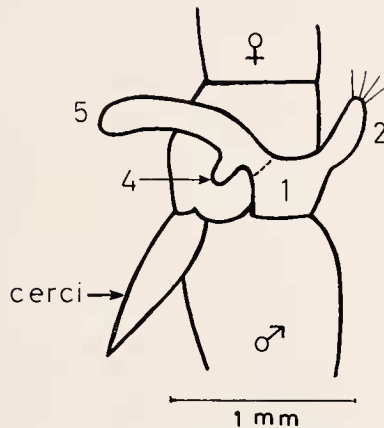


Fig. 3. Sketch of copulation in *Phyllolabis hemmingseni*. Numbers as in fig. 1. 3 is hidden. 2 protrudes more than in fig. 2, which represents a different pair.

sclerotized at the broad end. During copulation it is hidden, evidently because this is a part that possibly together with 7 and 8 firmly holds the hypovalves. In flies dried or preserved in Faester's fluid parts 5 from each side are crossed, but in live males they barely touch. Part 1 is less transparent than parts 3, 4 and 5.

It seems quite possible that the arc constituted by the mutually intervening hairs of parts 2 is an adaptation to the cerci, at the initiation of copulation, but this stage was of such short duration that in the few copulations seen this could not be decided.

Phyllolabis mannheimsiana Peder Nielsen, 1961.

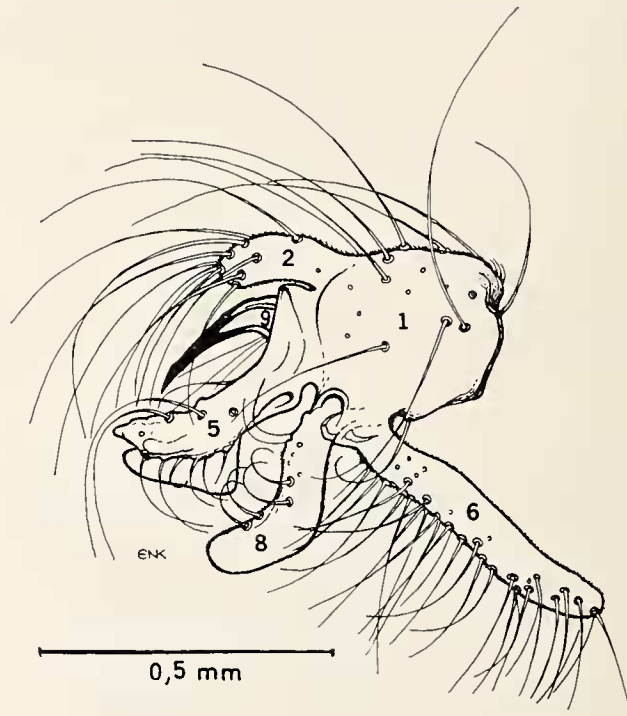
Fig. 4 shows the hypopygium of *Ph. mannheimsiana*.

Such parts as are, according to Dr. Alexander's sketch (in litt.), easily homologized with those of *Ph. hemmingseni*, are marked accordingly (1, 2, 5 and 6). The strongly sclerotized spine (9) which resembles in shape, and extends mesially like 7 in fig. 1 is, however, according to Dr. Alexander not a dististyle as 7 but a projection of the basistyle. The medial projection (8) is also present in this species.

In view of their similar position it is tempting to guess for 8 and 9 a similar function to 8 and 3 and possibly 7 in fig. 1, i. e. holding the hypovalves.

If the position during copulation of basistyle (1—2) and dististyle (5) can be inferred from their homologues in *Ph. hemmingseni*, 5 might grasp about the cerci or "stalk", but 2 would be too short to reach its counterpart on the other side.

However, when the hypopygium of a pinned male is viewed from behind the rather long hairs on the upper rounded edges of 2, as well as the less numerous hairs on 1, are seen to be curved inward, and from either side 5 meet below in the middle. Thus it might seem to be equally possible



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Fig. 4. The right part of the hypopygium of *Phyllolabis mannheimsiana*. Drawn from preparation in Canada balsam. The numbers homologize with fig. 1. 8 (like 9) extends mesially but is here bent backward; in fig. 1, forward.

that 2 with its hairs from each side grasps about the cerci or stalk, 5 rubbing their underside. The more hindward directed position of 2 and more downward directed position of 5 in *Ph. mannheimsiana* (fig. 4) than in *Ph. hemmingseni* (fig. 1) seems to be quite favourable to this possibility. But only direct observations can decide the point.

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Summary

The localities in Gran Canaria in which the author has collected *Phyllolabis hemmingseni* and *Ph. mannheimsiana* are summarized.

The highly complicated and branched hypopygial appendages of the male *Ph. hemmingseni* and the less complicated of *Ph. mannheimsiana* are described, homologized and pictured.

Copulation in *Ph. hemmingseni* is illustrated photographically and schematically. The long apically prominent projection of the dististyle grasps the „stalk“ (tergite 9) rostrally to the cerci of the female, whereas the inwardly curved hairs of the dorsally prominent projection of the basistyle intervene mutually from either side rhythmically on the ventral side of the female. The minor, dorsal, highly sclerotized projection from the dististyle is hidden during copulation, presumably because it serves fixation to the female hypovalves perhaps in conjunction with other, minor, mesal hypopygial projections.

Attempts to mate *Ph. mannheimsiana* were unsuccessful. Possible role of the hypopygial appendages in this species is discussed.

Zusammenfassung

Die vom Verf. festgestellten Fundorte von *Phyllolabis hemmingseni* und *Ph. mannheimsiana* auf Gran Canaria werden zusammengestellt.

Die hochkomplizierten und verzweigten Hypopyganhänge des Männchens von *Ph. hemmingseni* und die weniger komplizierten von *Ph. mannheimsiana* werden beschrieben, homologisiert und abgebildet.

Die Paarung von *Ph. hemmingseni* wird photographisch und schematisch illustriert. Der lange, hinten hervorragende Fortsatz des Dististylus umgreift den „Schaft“ (9. Tergit) rostral von den Cerci des Weibchens, während die nach innen gebogenen Haare des dorsal hervorragenden Fortsatzes des Basistylus von beiden Seiten auf der ventralen Seite des Weibchens rhythmisch zusammengreifen. Der kleine, dorsale, hochsklerotisierte Fortsatz des Dististylus ist während der Paarung verborgen. Vermutlich ist er an den Hypovalven des Weibchens, vielleicht zusammen mit anderen, kleinen Hypopygfortsätzen befestigt.

Paarungsversuche mit *Ph. mannheimsiana* gelangen nicht. Die Funktion der Hypopyganhänge während der Paarung bei dieser Art wird erörtert.

References

- Alexander, Ch. P. (1961): The Himalayan species of the genus *Phyllolabis* Osten Sacken (Diptera: Tipulidae). — Trans. R. ent. Soc. Lond. 113: 139—153.
- Hemmingsen, A. M. (1958): Adaptations in *Tipula (Lunatipula) lesnei* Pierre to the dry climate of Gran Canaria. — Vidensk. Medd. dansk naturh. Foren. 120: 207—236.

- (1962): Copulatory adaptations of male hypopygium to female tergal ovipository valves (cerci) in certain crane-flies (Tipulidae). — Vidensk. Medd. dansk naturh. Foren. 124: 135—163.
- Hem m i n g s e n , A. M., M a n n h e i m s , B., and N i e l s e n , P. (1959): Notes on crane-flies (Tipulidae) collected by Dr. Axel M. Hemmingsen in the Canary Islands. — Ent. Medd. 29: 71—77.
- M a n n h e i m s , B. (1959): Die europäischen *Phyllolabis*-Arten (Dipt., Limoniidae). — Bonn. zool. Beitr. 10: 149—156.
- N i e l s e n , P. (1959): Three new species of Limoniinae from the Canary Islands. — Ent. Medd. 29: 65—70.
- (1961): *Phyllolabis mannheimsiana* n. sp. from the Canary Islands (Diptera, Nematocera). — Ent. Medd. 31: 110—114.